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Maritimes Region
Canadian Science Advisory Secretariat
Science Advisory Report 2008/051

ST. MARY'S BAY LONGHORN SCULPIN (*MYOXOCEPHALUS OCTODECEMSPINOSUS*) ASSESSMENT

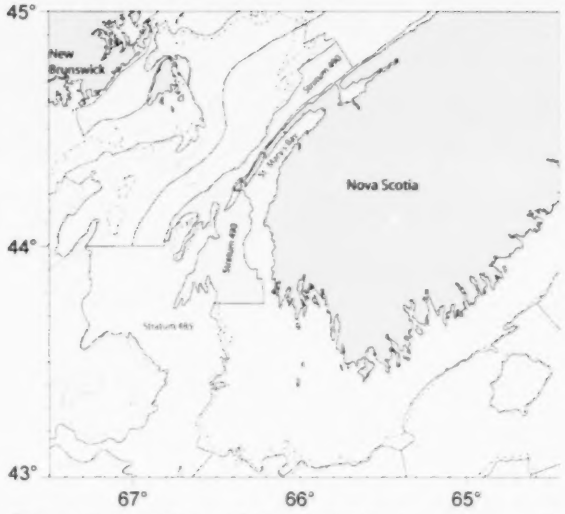

Figure 1. Locations of directed fishery and research survey strata.

Context

Fisheries and Aquaculture Management requested a review of the St. Mary's Bay, Nova Scotia, directed sculpin fishery to be completed prior to the 2008 fishery including a review of the biology of longhorn sculpin. An evaluation of the status of longhorn sculpin and the impact of the fishery on the environment was also requested.

The directed fishery for longhorn sculpin in St. Mary's Bay began in 1999. The fishery takes place over a 6 week period in April – May. There are currently 4 licenses in this fishery. The license requires each vessel to carry observers while fishing for sculpin. Initially they had 100% observer coverage, but in recent years this has been reduced to roughly 25% – 50% coverage. While fishing for sculpin, the vessels are permitted to use a 90mm diamond mesh codend.

Currently there is no Total Allowable Catch (TAC) in this fishery, and there has been no prior assessment of the status of longhorn sculpin in St. Mary's Bay.

SUMMARY

- Sculpin landings in 4X fluctuated between approximately 100 and 200t after the start of the directed fishery in 1999. The directed fishery is concentrated in the middle of St. Mary's Bay.

- Commercial catch rates of longhorn sculpin within St. Mary's Bay declined in the first few years of the directed fishery but appear to have stabilized. The catch rates from Stratum 490 of the DFO Research Vessel (RV) survey increased from the late 1970s to 1993 and then

subsequently declined. The catch rates from the Individual Transferable Quota (ITQ) survey are generally consistent with those observed in the RV survey.

- The abundance of larger (>23cm) longhorn sculpin in the directed fishery has declined, as has the mean length of sculpin from the RV survey in Stratum 490.

- Estimates of within-season exploitation rate on sculpin in St. Mary's Bay are substantial (greater than 30%). There was insufficient information to determine if such an exploitation rate is sustainable.

- While local depletion is probably occurring within St. Mary's Bay and adjacent areas, there is no evidence that sculpin in other areas of NAFO divs. 4VWX have been affected.

- The most abundant by-catch species caught in the St. Mary's Bay sculpin fishery from 1999-2006 were lobster, winter flounder, crabs, and sea raven. Although lobster by-catch is high, all animals are released and less than 1% have been reported as damaged or dead.

- The habitat over which the directed sculpin fishery takes place is highly energetic and of low bottom complexity. As a result, the impact of the sculpin fishery on the sea floor is expected to be low.

INTRODUCTION

Biology

Longhorn sculpin (*Myoxocephalus octodecemspinosus*) is a bottom dwelling fish located in the western Atlantic. In the North Atlantic, longhorn sculpin is distributed from the Strait of Belle Isle, Newfoundland to the coastal waters of Virginia. They are found in shoals and estuaries down to a depth of 192m. On the Scotian Shelf their preferred depth range is less than 90m. In a survey of near shore waters from the upper Bay of Fundy to Shelburne County, they were found to be most prevalent in St. Mary's Bay. At present, there is no information pertaining to population structure, although discontinuities in distribution could suggest population sub-structure.

Longhorn sculpin can reach a length of 45.7cm; however, they rarely grow larger than about 35cm. In southern New England waters they have been observed to be 5.5cm at Age 1, 18cm at Age 2, 21cm at Age 3, 25cm at Age 4, 27cm at Age 5, and 30cm at Age 6.

The exact timing of spawning in St. Mary's Bay is not well understood. However, in southern New England spawning takes place from late November through January. Spawning takes place inshore on rocky bottom where the average female deposits around 8000 eggs. The eggs are demersal, adhesive, and deposited in clusters on sponges or cavities on hard bottom. The eggs are 1.9-2.3mm in diameter and vary in colour from green to orange. On the Scotian Shelf, the larvae are present from March to May, and the duration of larval drift is around 30 days. The size of 50% maturity is reported to be 23cm for females and 24cm for males. All individuals larger than 30cm were mature.

Longhorn sculpin appear to be opportunistic feeders. Information available from analysis of sculpin stomach contents collected in Stratum 490 (see Figure 1) indicates that sculpin near St. Mary's Bay feed primarily on fish. More specifically, 50% of the diet (% weight) was

composed of fish, 11% was shrimp, and 9% was crab. Of the fish that were identifiable, haddock (26%) and sandlance (14%) were the most abundant. Lobster were not observed in the stomach contents of longhorn sculpin sampled in Stratum 490; in fact, lobster only occurred in the diets of longhorn sculpin collected in Stratum 485, where it comprised 8% of the diet. In most other areas of the Gulf of Maine and the Scotian Shelf, sculpin were found to feed more extensively on invertebrates.

The opercular and pre-opercular spines of the longhorn sculpin are thought to limit predation on this species. Longhorn sculpin have been detected as prey items for 10 fish species in the Gulf of Maine. The 8 most common predators in the Gulf of Maine are cod, spiny dogfish, winter skate, sea raven, little skate, monkfish, white hake, and other longhorn sculpin. They have also been detected as prey for cormorants. In an analysis of approximately 6000 predator stomachs collected by DFO in 4X, sculpin occurred in very few stomachs (<1%) and for only 4 species (Atlantic cod, Atlantic halibut, winter skate, and sea raven).

Rationale for Assessment

Advice was requested by Fisheries and Aquaculture Management on the status of longhorn sculpin in St. Mary's Bay, specifically:

- Review species life history and status inside and outside St. Mary's Bay.
- Describe the directed fishery.
- Describe sculpin catches in other fisheries.
- Evaluate relevant survey information.
- Evaluate the impact of the sculpin fishery on the ecosystem.

The Fishery

Sculpin **landings** first appeared in the Maritimes Region landings statistics in the early 1990s. The fishery at that time was a by-catch fishery mainly from the Bay of Fundy, Gulf of Maine, and Brown's Bank areas. Landings were at low levels until the introduction of the directed fishery in St. Mary's Bay in 1999, at which point catches increased to fluctuate between approximately 100 and 200t (Table 1, Figure 2). The majority of the sculpin caught in other fisheries are caught outside St. Mary's Bay. There was no directed fishery in St. Mary's Bay in 2007 and 2008.

Table 1. Sculpin landings (tonnes).

Years	1990-1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
4VW	0.2	0	0	0	0	0	0	0	9	4
4X	23.5	83	166	173	148	122	107	181	189	141
TOTAL	23.7	83	166	173	148	122	107	182	198	145
Directed	–	62	141	152	106	78	52	95	99	–

Note: Landings of sculpin may include small quantities of sea raven.

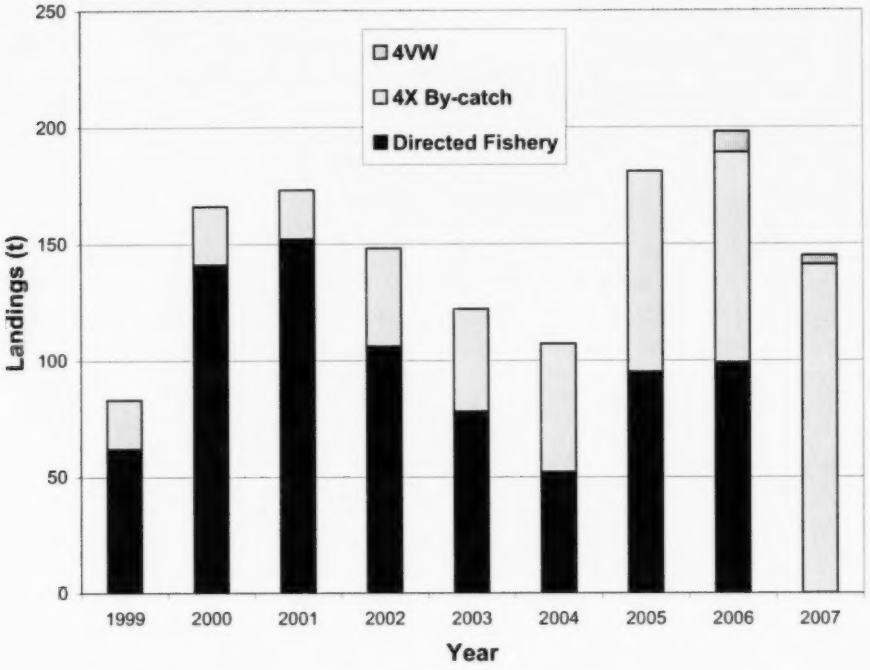

Figure 2. Longhorn sculpin landings from 1999 to 2007 in 4VWX.

A directed fishery began in 1999 using Generalist vessels with mobile gear less than 65 feet. These vessels were permitted to direct for sculpin in St. Mary's Bay using 90mm diamond mesh otter trawls. Vessels were required to carry observers while using the small mesh gear. This coverage varied from 100% in the early years to roughly 25 - 50% coverage through 2003 – 2006.

Based on reported catches from fishing logs, the **primary concentration** of the directed fishery is in the middle of St. Mary's Bay (Figure 3).

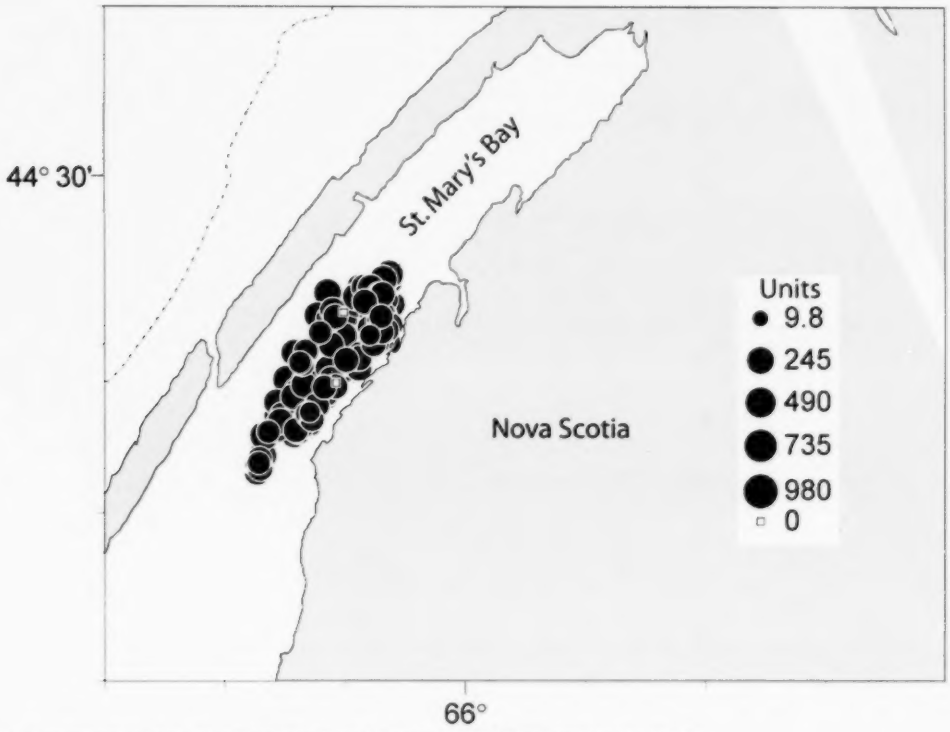

Figure 3. Location of the directed sculpin fishery in St. Mary's Bay in 2002.

ASSESSMENT

Abundance Indices

At present, there are no fishery-independent estimates of abundance for longhorn sculpin in St. Mary's Bay since no research surveys have been conducted in this area. However, there is information on fishery catch rates of sculpin, and some research survey information is available from the areas just outside of St. Mary's Bay.

Commercial catch rates of longhorn sculpin from the directed fishery peaked in 2000 and have remained relatively stable since 2002 (Figure 4).

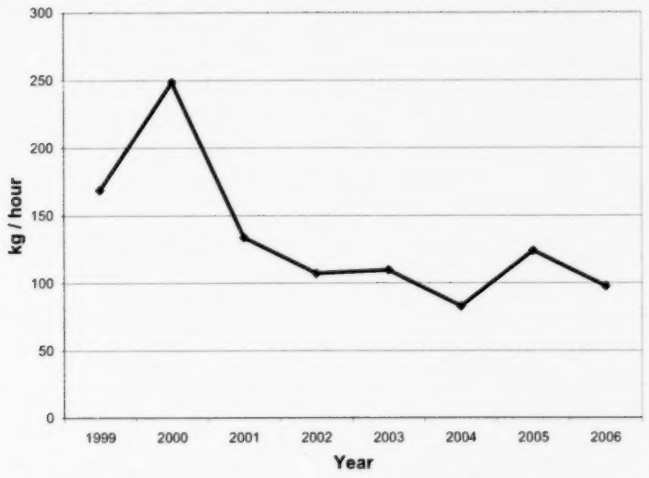

Figure 4. Observed catch rates of longhorn sculpin in the directed sculpin fishery.

DFO's summer Research Vessel (RV) survey covers 4VWX, and has been conducted since 1970. The catch rate of longhorn sculpin from the 4X portion of the RV survey has been low but relatively stable since 1970; however, the catch rate from Stratum 490 of the RV survey increased from the late 1970s to 1993 and then subsequently declined (Figure 5).

Since 1996, the Individual Transferable Quota (ITQ) fleet has been conducting a fixed station bottom trawl survey of 4X. The ITQ survey is a much shorter time series but it extends further inshore towards St. Mary's Bay. Figure 5 indicates that the sculpin catch rates from the ITQ survey are generally consistent with those observed in the RV survey.

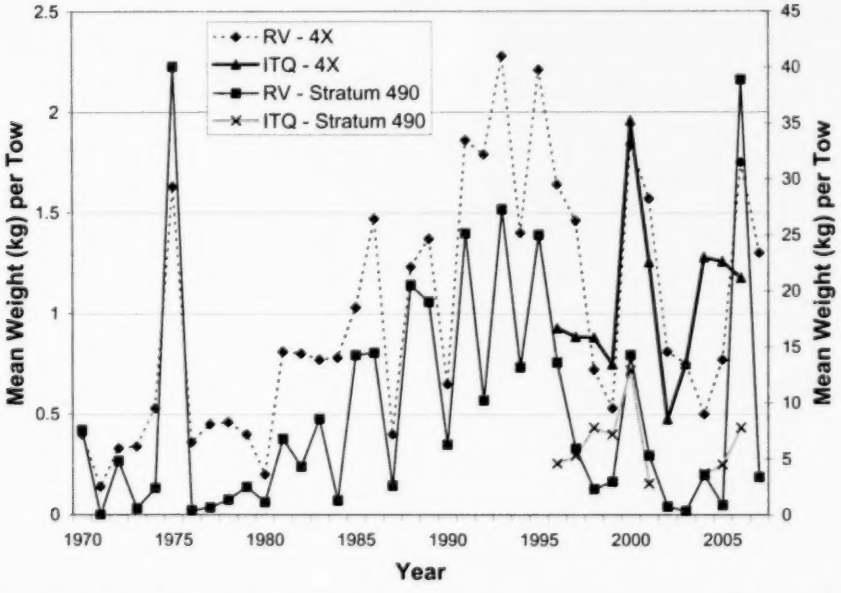

Figure 5. Catch rate of longhorn sculpin caught in the 4X portion and Stratum 490 of the RV Survey and the ITQ Survey.

Distribution

The RV survey shows concentrations of longhorn sculpin in the Bay of Fundy, Gulf of Maine, Browns Bank, Western Bank, and Banquereau. In the Bay of Fundy, the RV survey does not cover St. Mary's Bay.

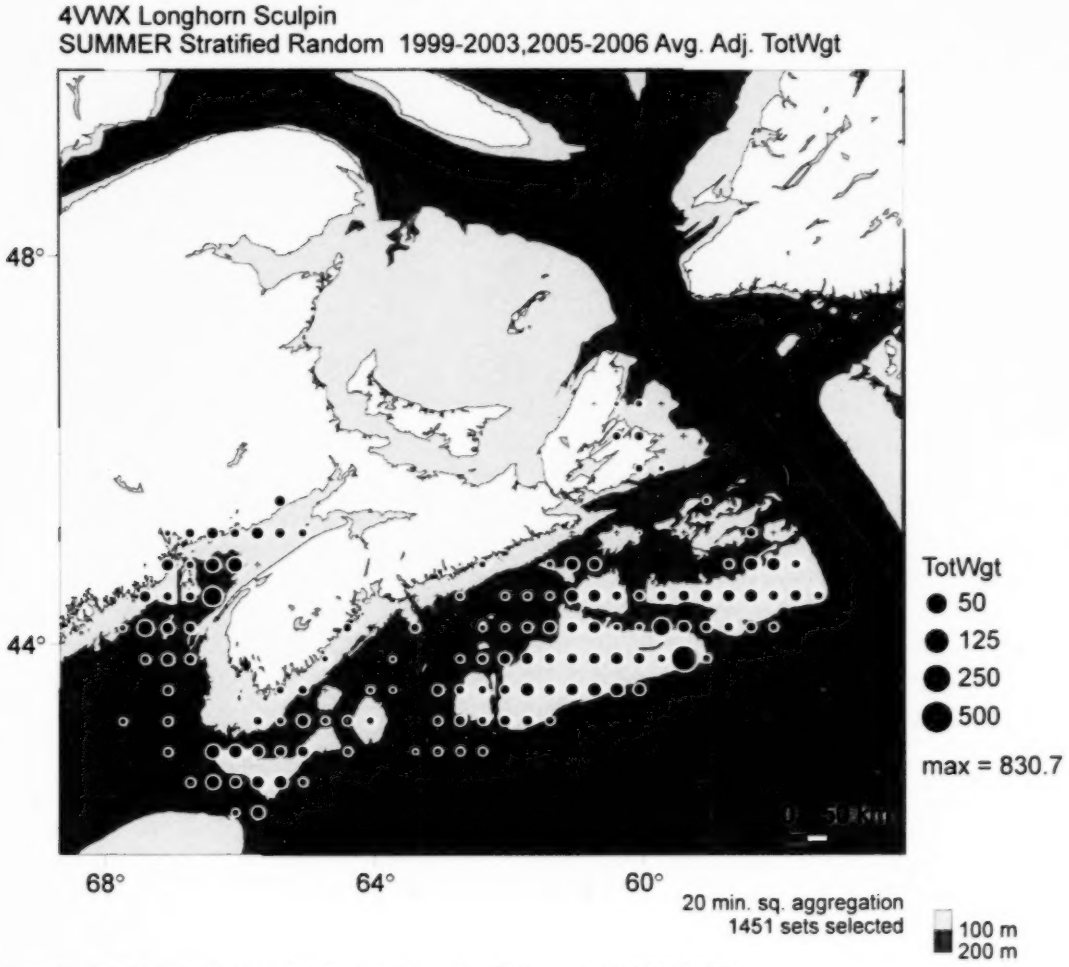

Figure 6. Longhorn sculpin distribution from the RV survey (1999-2007).

The ITQ survey shows a similar distribution to the RV survey with longhorn sculpin mainly being found in the Bay of Fundy, Gulf of Maine, and Browns Bank (Figure 7). This survey has coverage inshore of the area covered by the RV survey and shows that longhorn sculpin are also found on German Bank.

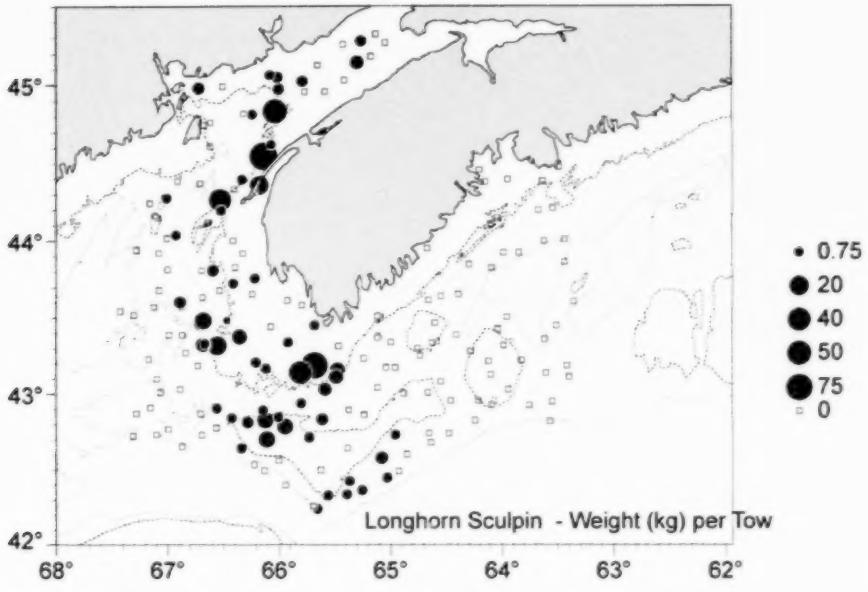

Figure 7. Longhorn sculpin distribution in the ITQ survey (1996-2006).

Size Composition

During the fishery, at-sea observers collected length frequency data on longhorn sculpin and winter flounder. The **mean length** of sculpin in the directed fishery has declined. A separation of the catch into large (>23cm) and small (<=23cm) fish indicates that the catch is primarily composed of fish greater than 23 cm (Figure 8). A large increase in the abundance of small fish in the catch was not observed.

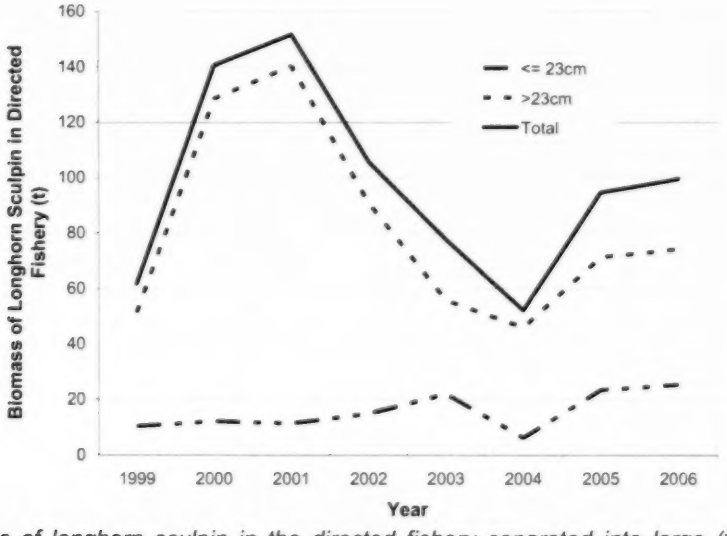

Figure 8. Biomass of longhorn sculpin in the directed fishery separated into large (>23cm) and small (<=23cm) fish.

Longhorn sculpin length frequencies from the RV survey also show a decline in mean length over the course of the survey time series (Figure 9). The mean lengths observed in Stratum 490 and 4X are similar until 1996 but subsequently diverge. In 1997 and 1998, the decrease in mean lengths appears to be related to an increase in recruitment. Since then, the reason for reduced mean length in Stratum 490 is less clear.

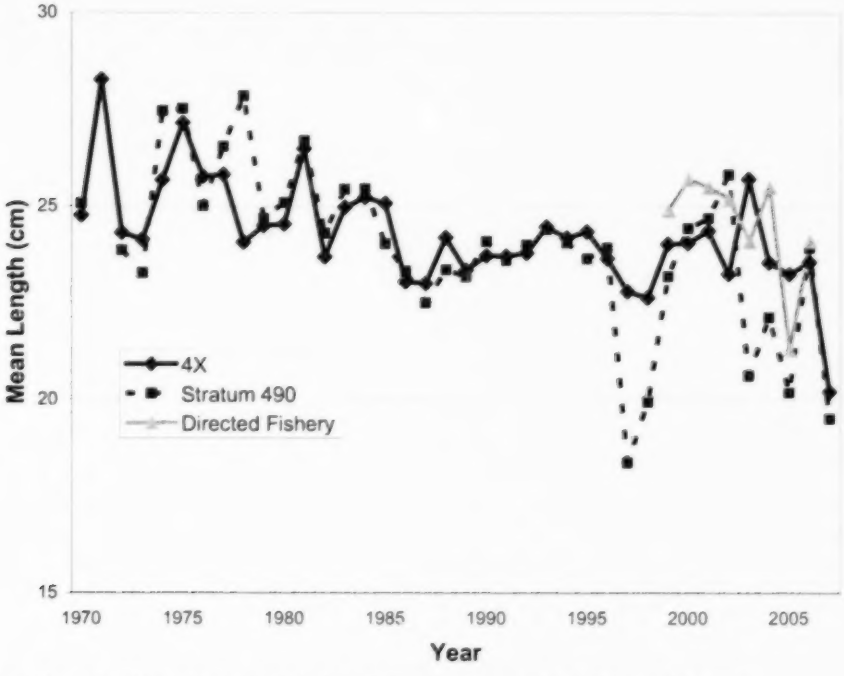

Figure 9. Mean length of longhorn sculpin in the RV survey and the directed fishery.

Length frequency histograms show evidence of recruitment in areas adjacent to St. Mary's Bay and more broadly in 4X, indicating that recruitment occurs in other areas as well.

Based on a comparison of the size composition of the commercial catch with that of the RV survey in Stratum 490, there appears to been a decline in the abundance of large fish in St. Mary's Bay, which may be reflecting local depletion.

Exploitation Rate

Absolute biomass in the fished area of St. Mary's Bay was approximated using mean observed commercial catch rate, the number of trawlable units, and a literature based estimate of sculpin catchability. A second estimate was generated using RV catch rates in adjacent areas. The resulting biomass estimates were similar in magnitude to the mean annual sculpin catch, suggesting that true catchability was less than estimated. However, even if true catchability was one third of that assumed, mean annual exploitation rate in St. Mary's Bay exceeded 30%. Thus, it appears that the within-season exploitation rate on sculpin in St. Mary's Bay is substantial. There was insufficient information to determine if such an exploitation rate is sustainable. However in general, fast-growing fishes with an early age of maturation can sustain higher exploitation rates than slower-growing species such as cod. The influence of this

exploitation rate on the population as a whole would depend on the extent of inter-annual mixing and recruitment with areas outside St. Mary's Bay.

ECOSYSTEM IMPACTS

By-catch

At-sea observers recorded a total of 61 species of fish and invertebrates caught in the directed sculpin fishery. Lobster is the most significant by-catch species by weight and is roughly 10% of the longhorn sculpin catch. By-catch of groundfish remained relatively unchanged for the first 6 years of the directed fishery; however, in 2005 and 2006 there was an increase in sea raven and skate catches (Figure 10).

The length distribution of winter flounder is showing an increase in smaller animals in 2005 and 2006, which appears to be a positive sign of incoming recruitment.

Winter flounder catch rates in the sculpin fishery show a large decline from 2000 to 2001, but have increased in recent years. The catch rates of sea raven have increased steadily during the course of the fishery. Ocean pout shows the largest decline in catch rates of any species caught as by-catch in the sculpin fishery and have remained at very low levels since the early part of the fishery.

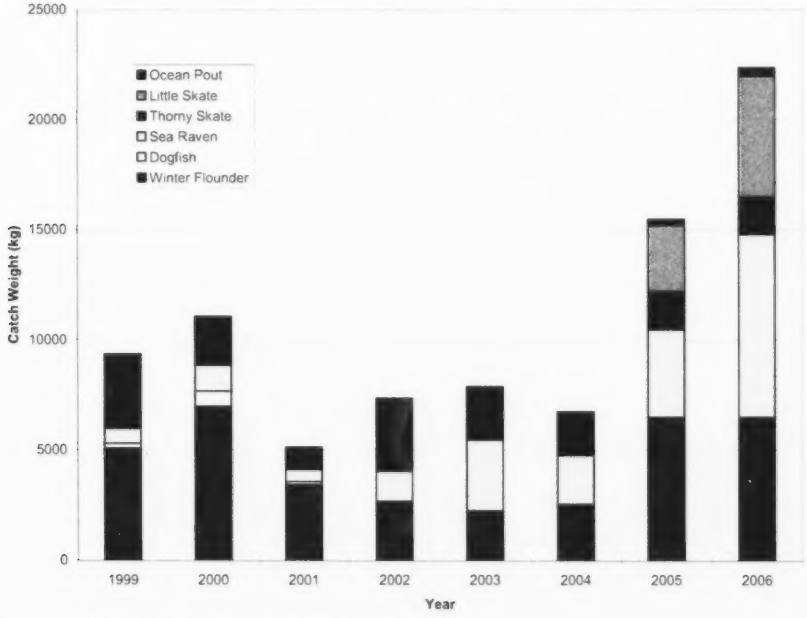

Figure 10. Finfish by-catch in the directed sculpin fishery.

Winter flounder and lobster are caught in the majority of commercial sets. Since 2003, sea raven and Jonah crab were captured in greater than 90% of all sets.

The three main invertebrate species caught in the longhorn sculpin fishery are lobster, Jonah crab, and rock crab (Figure 11). Lobster is the largest component of this catch. Lobster

catches have fluctuated but increased in both 2005 and 2006. Lobster catch rates show an increase over the course of the sculpin fishery.

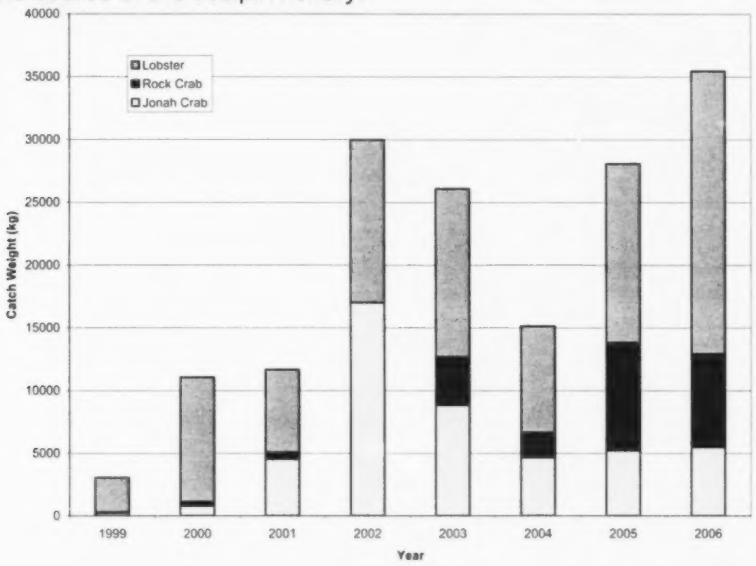

Figure 11. Invertebrate by-catch in the directed sculpin fishery.

Landings of Lobster in St. Mary's Bay by the Directed Lobster Fishery

Given its relatively small size, St. Mary's Bay is one of the more productive fishing areas for lobster in Atlantic Canada. From 1999 to 2006, landings in St. Mary's Bay comprised an average of 1180t. This is comparable to or greater than several Lobster Fishing Areas (LFAs) outside of LFA 34. As a percentage of total directed lobster landings by the LFA 34 fishery, St. Mary's Bay comprised 6-7%. In the area most closely associated with the directed sculpin fishery, the average annual directed lobster landings for 1999-2006 was 203t. The annual average lobster by-catch in the directed sculpin fishery was 11t, all of which was returned to the water. Observer reports indicate most lobsters (99%) were released alive and uninjured.

Habitat Impacts

Description of the Area of St. Mary's Bay Where the Sculpin Fishery has Occurred

The area of sculpin fishing occurs primarily at depths of 10 to 35m. Underwater video surveys for lobster in late summer to early fall in St. Mary's Bay provide some information on the bottom type and species encountered. Video transects confirmed the presence of several observed by-catch species in the area in late summer. Lobsters and crabs were abundant in the area of the directed sculpin fishery. During the video transects the bottom type was noted as mud, sand, gravel, cobble, boulder, or combinations of these sediment types. Within the area where the sculpin fishery occurred, the ocean bottom can be characterized as primarily sand, mud, gravel, and shell hash. Mud burrows were observed in some locations, which offer shelter for animals such as lobsters. Outside of the sculpin fishing area, the bottom type was as above but with the addition of more rough bottom (cobble and boulder with kelp).

Potential Benthic Impacts of Trawling for Sculpins

In the absence of direct information pertaining to the benthic impacts associated with this fishery, the results of a national meeting provide a review and advice on the effects of trawl gears and dredges. Experts prepared an overview working paper that reviewed and consolidated the results of five major international reviews or symposia, as well as several additional working papers that considered results of regional studies of these impacts in Canada. Based on the findings of these experts and the fact that the directed sculpin fishery is conducted in an area of low bottom complexity and high energy (currents generated by tides, wind, and storms), the physical effects on the bottom and the effects on communities is expected to be low relative to other areas. However, the consequences of trawling on burrows have not been assessed. Where the sculpin fishery trawls on harder, more complex bottom, a reduction of habitat by structural damage is expected. Other bottom contacting fisheries occur in St. Mary's Bay, but the impact of those fisheries on the ocean bottom has not been assessed.

Sources of Uncertainty

Population structure is unknown, including source of recruits and the extent of movement among areas.

There is no directed survey for sculpin and a fishery-independent abundance estimate is lacking.

A reliable estimate of sculpin catchability is unavailable for use in estimating exploitation.

Productivity, size at maturity, sustainable exploitation rate, and other reference points are all unknown.

The by-catch of sculpin in other fisheries in St. Mary's Bay is unknown.

The consequences of removals on ecosystem structure are unknown.

CONCLUSIONS AND ADVICE

Based on observer reports, catch rates of longhorn sculpin within St. Mary's Bay declined in the first few years of the directed fishery but appear to have stabilized. The abundance of larger (>23 cm) longhorn sculpin in the directed fishery has also declined, as has the mean length of sculpin from the RV survey in Stratum 490. The catch rates from Stratum 490 of the RV survey increased from the late 1970s to 1993 and then subsequently declined. The sculpin catch rates from the ITQ survey are generally consistent with those observed in the RV survey. Estimates of the within-season exploitation rate on sculpin in St. Mary's Bay are substantial (greater than 30%). There was insufficient information to determine if such an exploitation rate is sustainable. While local depletion is probably occurring within St. Mary's Bay and adjacent areas, there is no evidence that sculpin in other areas of 4VWX have been affected.

The most abundant by-catch species caught in the St. Mary's Bay sculpin fishery from 1999-2006 were lobster, winter flounder, crabs, and sea raven. Although lobster by-catch is high, all animals are released, and less than 1% have been reported as damaged or dead. There is poor understanding of any sub-lethal effects on lobsters after they are released.

The habitat over which the directed sculpin fishery takes place is highly energetic and of low bottom complexity. As a result, the impact of the sculpin fishery on the sea floor is expected to be low. Other bottom contacting fisheries occur in St. Mary's Bay, but the impact of those fisheries to benthic habitat has not been assessed.

FOR MORE INFORMATION

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